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Prognostic impact of infection on mortality in geriatric patients admitted to the cardiac intensive care unit

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Abstract

Aim: Infection causes morbidity and mortality in the elderly population, especially in intensive care units. Increasing age causes multiple co-morbidities, immune system, and multiorgan disturbances, and frailty. Elder population is prone to infections. There are little data about the impact of infection on short and long-term mortality in coronary intensive care units in elderly cases.

Material and Methods: Data from 466 patients aged 70 years and older admitted to the coronary intensive care unit between January 2010 and December 2014 were retrospectively reviewed.

Results: Patients with infection had higher in-hospital and 30-day mortality rates. There was no difference between groups regarding long-term mortality. The presence of infection was found to be an independent predictor of in-hospital mortality. The occurrence of infection was not associated with long-term mortality. In multivariate Cox regression analysis, age, previous CHF, and ACS type were independent predictors of long-term mortality.

Discussion: Infection was independently related to hospital mortality in the geriatric group in the coronary intensive care unit but had no impact on long-term mortality.

Keywords

Coronary Intensive Care Unit, Infection, Mortality, Elder

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Introduction

The definition of the geriatric population applies to patients aged 65 years or older. The number and population ratio of this age group is growing worldwide. According to data from the Turkish Statistical Institute, while the population over 65 was 8.3% in 2016, this rate increased to 9.7% in 2021. Consequently, this age group accounts for over 10% of patients admitted to the intensive care unit [1,2]. Intensive care units are at risk of infection as they are areas where invasive interventions such as mechanical ventilation, tracheostomy, and permanent vascular access are applied. Elderly patients admitted to the coronary intensive care unit are at high risk of mortality due to their primary diagnosis, and infections are the main cause of admission to non-cardiac ICU, and this rate has increased over the years [3]. The presence of underlying chronic conditions, changes in the immune system and multiple organ systems with aging increase the risk of infection in these patients [4-6]. It is estimated that the elderly population represents 60% of all intensive care days. Long-term hospitalization causes an increase in the rate of nosocomial infections and especially the severity of the disease, the use of antibiotics as well as the use of multiple invasive procedures. Early and accurate diagnosis and the start of treatment are very important to morbidity and mortality, particularly in this group of cases. Epidemiological studies are limited, especially in the elderly patient group followed in the intensive care unit. Respiratory infections are most frequent in intensive care infections, followed by urinary tract infections and bloodstream infections, including catheter infections. In the geriatric population, the immune system is adversely affected by a reduced capacity of phagocytosis, gastrointestinal dysmotility, mitochondrial dysfunction, a reduced liver mass and blood circulation, 1% decrease in glomerular filtration rate, which is one of the renal functions, and hyposalivation [5,6,7,8,9]. Sixty percent of diagnosed cases of sepsis have been reported to be over the age of 65 [10,11]. The presence of comorbidities, especially in this group, contributes to the development of intensive care infection. In addition, due to hepatic and renal comorbidities, caution is advised in the use of medication in this patient group.

Overall, literature data on long-term mortality in patients followed in the intensive care unit are limited. For geriatric patients followed in the coronary intensive care unit (CICU), data on the effect of infection on early mortality are available, but data on the long-term effect are very limited [12]. The aim of this study was to investigate the effect of infection on mortality in the short and long term in geriatric patients followed in the coronary intensive care unit.

Material and Methods

Data from 531 patients aged 70 years and older admitted to the coronary intensive care unit between January 2010 and December 2014 were retrospectively reviewed. Epidemiological and clinical data of the patients were retrieved from medical records. Sixty-five patients with missing data were excluded from the study. The final study population was 466 patients.

Infections within the first 72 hours of admission to the CIC unit were considered community-acquired, and infections after 72 hours were considered hospital-acquired. The presence of the infection was identified by an infectious disease specialist, and appropriate samples were collected for culture to initiate empirical antibiotic therapy. In the course of the patient's hospitalization, necessary treatment changes were made based on the results of the culture antibiogram and the patients' clinics.

All-cause in-hospital and long-term mortality were the primary endpoints of our study.

Statistical analysis

Continuous variables were presented as mean ± standard deviation, and categorical variables were presented as the number of subjects with the percentage of the total number. A comparison of parametric values between the two groups was performed using Student's t test or the Mann-Whitney U test, as appropriate. A chi-squared test was used to compare categorical variables between the groups. The Kaplan-Meier method was used to obtain the cumulative survival for mortality. Significant differences in the survival curves were shown by the the log-rank test. Multivariate Cox regression analysis was carried out to identify independent predictors of mortality. Factors entered into the multivariate model comprised those with p-values < 0.1 from the univariate analysis. All statistical tests were two-tailed; a P- value <.05 was considered statistically significant. All analyses were performed using SPSS version 26 (SPSS, Inc.; Chicago, IL, USA).

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Ethical Approval

Ethics Committee approval for the study was obtained.

Results

This study included 466 patients. The baseline characteristics of patients are provided in Table 1. The mean age was 78.67 ± 5.9 years, 49.6 % of the patients were male. The most common primary diagnosis was acute coronary syndrome (ACS: 50%), including ST-segment elevated acute coronary syndrome (STEMI) (21.7%), non-ST segment elevation acute coronary syndrome (NSTEMI) (20.4%), and unstable angina pectoris (USAP) (7.9%). Heart failure (CHF) represented the second most common diagnosis (22.2%).

One hundred seventy-two (36.9%) patients had an infection. Patients with infection were older than those without infection (80.2 ± 6.4 vs. 77.8 ± 5.4, p < 0.001), p < 0.001; 44% vs. 18%, p < 0.001, respectively). Of these infections, the source and number of episodes were pulmonary (%90), urinary (%86), pulmonary and urinary (%27), wound (%7), skin-soft tissue (%6), and bloodstream infections (%2), respectively. The causative microorganisms due to specimens collected were E coli 22 (%62.8) in urinary tract infection, 12 (%44.4) coagulase-negative Staphylococcus in blood samples, 2 (%40) Acinetobacter spp. in wound specimens, 1(%50) Klebsiella pneumoniae in sputum samples, and 1 (%50) Pseudomonas spp. in thoracal aspiration specimens. In E. coli isolates from the urinary tract extended-spectrum, beta-lactamases (ESBL) rate was %36.3, ampicillin resistance of enterococcus was %40, ESBL rate was %33.3 in Klebsiella spp. strains and Pseudomonas strains were %100 inducible-beta lactamases (IBL) positive. When we evaluated blood samples, methicillin resistance was %100 in coagulase-

negative Staphylococcus, ampicillin resistance in Enterococcus spp. was %50, methicillin-resistance in Staphylococcus aureus (MRSA) was %50, and %100 in ESBL Escherichia coli, and in ESBL Klebsiella pneumoniae. Pulmonary specimens revealed only one carbapenem and colistin-resistant Pseudomonas spp. The rates of acute renal failure, the need for inotropic support, mechanic ventilation, non-invasive ventilation, and in-hospital mortality were higher in patients with infection compared with those without (p<0.001). When we evaluated the laboratory results, patients with infection had higher white blood cell count (WBC), C-reactive protein (CRP), blood urea nitrogen (BUN), and creatinine levels than controls (p<0.001).

Prognostic impact of the occurrence of infection

Patients with infection had higher in-hospital and 30-day mortality rates (59% vs. 43%, p < 0.001, 11% vs. 2%, p < 0.001, respectively). The mean follow-up duration was 8.59 ± 1.51 years. There was no difference between groups regarding long-term mortality (39% vs. 34%, p = 0.251). The presence of infection was found an independent predictor of in-hospital mortality (HR:2.148, 95%CI:1.073-4.303, p = 0.031, Table 2).

Table 1. Baseline characteristics of the study population

Variables	No-Infection (n = 294)	Infection (n = 172)	p-value
Age, years	77.8 ± 5.4	80.2 ± 6.4	<0.001
Female gender (%)	140 (48)	95 (55)	0.113
Hypertension, n (%)	96 (33)	51 (30)	0.501
Diabetes mellitus, n (%)	87 (30)	67 (39)	0.038
Previous CKD, n (%)	51 (17)	47 (27)	0.011
Previous CHF, n (%)	110 (37)	92 (54)	0.001
Asthma or COPD, n (%)	25 (9)	36 (21)	<0.001
Previous CAD, n (%)	200 (68)	87 (51)	<0.001
Cancer, n (%)	13 (5)	9 (5)	0.690
Previous stroke/TIA, n (%)	20 (7)	19 (11)	0.110

Abbreviations: CAD: coronary artery disease, COPD: chronic obstructive pulmonary disease, CKD: Chronic kidney disease, CHF: Chronic heart failure, TIA: Transient ischemic attack

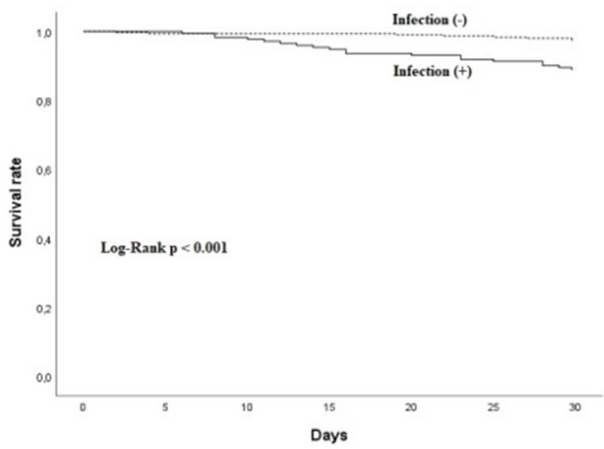

Figure 1. Kaplan-Meier event-free survival curves according to the presence of infection at 30-day follow-up

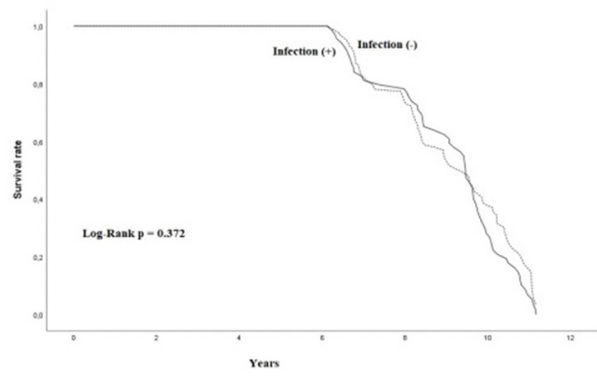

Figure 2. Kaplan-Meier event-free survival curves according to the presence of infection at long-term follow-up

Table 2. Univariate and multivariate analysis for predictors of in-hospital mortality

Variable	Univariate HR 95%CI	p value	Multivariate HR 95%CI	p value
Age	1.051 (1.018-1.085)	0.002	1.054 (1.006-1.104)	0.026
Infection	2.047 (1.396-3.001)	<0.001	2.148 (1.073-4.303)	0.031
Previous CHF	1.671 (1.155-2.417)	0.006		
Previous stroke	2.554 (1.260-5.174)	0.009	3.605 (1.460-8.901	0.005
Respiratory failure	5.688 (2.314-13.979)	<0.001	8.818 (2.751-28.262)	<0.001
Cardiogenic shock	2.487 (1.059-5.839)	0.036	4.206 (1.171-15.110)	0.028
ACS type	1.200 (1.036-1.395)	0.015	1.548 (1.240-1.931)	<0.001
Vasopressors	18.482 (9.564-35.715)	<0.001	25.023 (10.878-57.560)	<0.001
Red blood cell transfusion	2.743 (1.295-6.092)	0.013	3.467 (1.027-11.705)	0.045
Acute renal failure	8.369 (4.028-17.387)	<0.001	3.177 (1.221-8.266)	0.018
LVEF	0.985 (0.973-0.998)	0.022		
CRP	1.007 (1.002-1.013)	0.006	1.008 (1.000-1.016)	0.045
Hemoglobin	0.903 (0.827-0.986)	0.023	1.028 (1.010-1.047)	0.003
WBC	1.000 (1.000-1.000)	<0.001	1.000 (1.000-1.000)	<0.001
BUN	1.031 (1.022-1.040)	<0.001		
Creatinine levels	2.424 (1.892-3.106)	<0.001		

Abbreviations: HR: hazards ratio, CRP: C-reactive protein, LVEF: left ventricular ejection fraction

Table 3. Univariate and multivariate analysis for predictors of long-term mortality

Variable	Univariate HR 95%CI	p value	Multivariate HR 95%CI	p value
Age	1.052 (1.024-1.080)	<0.001	1.051 (1.022-1.081)	0.001
Infection	1.153 (0.843-1.577)	0.373		
Previous CHF	1.447 (1.064-1.968)	0.019	1.372 (1.007-18.71)	0.045
Previous stroke	1.742 (0.913-3.320)	0.091		
Respiratory failure	0.800 (0.353-1.817)	0.594		
Cardiogenic shock	1.223 (0.600-2.495)	0.580		
ACS type	2.477 (1.426-4.303)	0.022	2.386 (1.372-4.149)	0.002
Vasopressors	1.285 (0.694-2.379)	0.425		
Red blood cell transfusion	1.070 (0.543-2.107)	0.845		
Acute renal failure	1.041 (0.502-2.159)	0.913		
LVEF	0.985 (0.975-0.995)	0.004		
CRP	1.002 (0.998-1.013)	0.306		
Hemoglobin	0.947 (0.879-1.019)	0.143		
WBC	1.003 (0.998-1.007)	0.527		
BUN	1.001 (0.995-1.007)	0.808		
Creatinine levels	1.105 (0.955-1.279)	0.180		

Abbreviations: HR: hazards ratio, CRP: C-reactive protein, LVEF: left ventricular ejection fraction

In multivariate Cox regression analysis, age, previous CHF, and ACS type were independent predictors of long-term mortality (Table 3). The occurrence of infection was not associated with long-term mortality (HR: 1.153, 95%CI: 0.843-1.577, p = 0.373). Kaplan-Meier survival curves for the patients according to the presence of infection were presented in Figures 1 and 2 for both 30-day and long-term follow-up.

Discussion

This study investigated the short- and long-term effects of infection on mortality in geriatric patients followed in the coronary intensive care unit.

Increasing incidence of chronic diseases with aging, increased fragility, nutritional problems, physiological changes and polypharmacy result in an increase in the occurrence and severity of infection in geriatric patients. The incidence of cardiac failure increases with age and this situation is a risk for infection in hospitalized patients [2]. Likewise, in our study, the incidence of cardiac failure was higher in the group that developed infection.

When we examined the infections of the patients, we observed that the pulmonary focus was the first to be encountered, followed by urinary, pulmonary, and urinary, wound and skin soft tissue infections. Pulmonary predominance among intensive care patients in the geriatric population was reported in the literature in parallel with our study [13]. In this study, the rate of resistant pathogens was lower than in studies in other intensive care units, which can be due to shorter hospital stays in intensive care units.

The geriatric age group is growing globally, and this is also increasing the rate of hospitalization of geriatric patients in intensive care units [2]. Changes in body organs and tissues, changes in immunological status, and differences in the inflammation process with age predispose this group of patients to infections. In addition, common conditions that increase the susceptibility to infection, such as diabetes, kidney failure, and immune suppression, in geriatric ages are also a negative effect. Indistinction or differences in clinical outcomes cause difficulties in predicting the focal point of infection, while the low isolation rates of causative pathogenic microorganisms and resistant infectious agents make it difficult to manage the picture in this group of patients [14]. Enterobacteriaceae were the first, while Candida spp. was the second agent identified in the studies [2]. In our study, pulmonary focus was the most common, and the isolated number of the causative agent was not as high as expected, whereas urinary focus was the second most common with E.coli from the Enterobacteriaceae the most frequently isolated causative agent similar to these literatures. We showed that the presence of infection in patients admitted to the ICU was independently associated with in-hospital mortality however this relationship did not occur at long-term follow-up in this presented study. The association with mortality in infected cases in the short term is related to the multiple comorbidities, organ failures, and immunological conditions of the patients. We suggest that the lack of effect on mortality in the long term can be associated with the fact that, in general, if infectious diseases do not cause sequelae in the chronic process, a mortal course will not be expected.

Limitations of the study

The limitations of our study are the retrospective design and inclusion of only a single center. The geriatric age group is a special group having comorbidities, altered immune status, and polypharmacy applications. Early diagnosis and treatment of nosocomial infections are important, especially for preventing short-term mortality in elder intensive care unit cases.

Conclusion

Infection is independently associated with hospital mortality in the geriatric group in the coronary intensive care unit but had no impact on long-term mortality.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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